Organization: University of California, Santa Barbara

MTO **Simbiosys**

Title: Optical Properties of Bound Antigen Monolayers for Biomolecular Microsensors

Start Date: August 2001 **End Date:** August 2002

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Project Goals

Analyze the impact on microsensor performance of the index and absorption, birefringence, and scattering properties of a variety of antigens bound to low-index and high-index optical surfaces. Collate and analyze the existing data scattered through the biochemical literature, make measurements on a representative set of antigens, and build a database useful to sensor engineers.

Technical Approach

- Choose antigens of interest with guidance from DARPA/DoD, and ThauMDx.
- Analyze existing data, and perform measurements using spectroscopic ellipsometry, waveguide coupling, laser cavity sensing, and video image analysis. Examine the near UV to the mid IR, where diode laser and LED sources are now available.
- Model the effects of these optical properties on evanescently-coupled sensors, considering both dielectric and semiconductor optical components.

Recent Accomplishments

- Developed accurate model for the evanescent field overlap with thin antibody-antigen layers, and verified the model with data from a Bioflips program (Tunable Laser Cavity Sensor, C. Meinhart.)
- Surveyed five decades of literature on the optical index and absorption of amino acids and proteins. Ample index data exists at 589 nm, but little data at wavelengths of interest to integrated microsensors.
- Began a Kramers-Kronig analysis to obtain spectrally-resolved index information from the extensive spectral absorption data that exists.
- Began characterization of experiment to measure spectrally-resolved index of proteins by Total Internal Reflection (TIR)
- Compiled a list of commercially-relevant antibody-antigen pairs, to be combined with model systems suggested by the military community, as candidates for detailed measurements.

Six-Month Milestones

- Complete the analysis of the impact of antigen optical properties on the performance of integrated microsensors.
- Identify canonical films for detailed measurement.
- Set up experiments for direct measurement of the optical properties of representative films.

Team Member Organizations

N/A

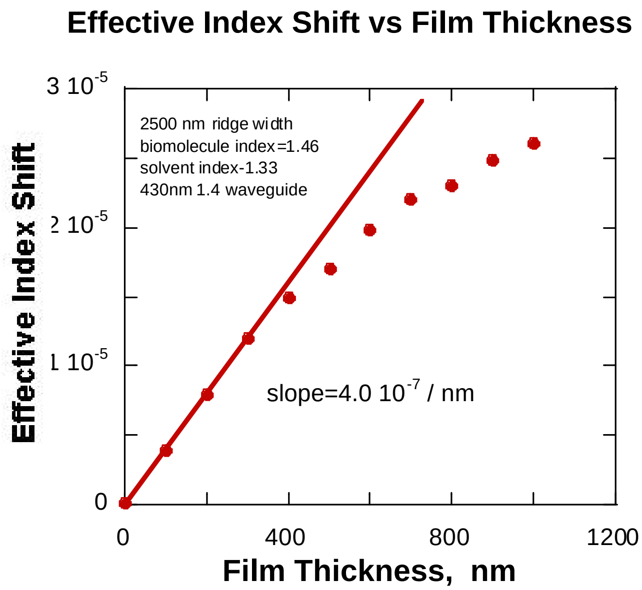

Figure 1. Effective index shift in an InGaAsP waveguide, as a function of the thickness of an adsorbed biomolecular layer. When used in a Tunable Laser Cavity Sensor (Meinhart-Bioflips), the slope of this curve corresponded to a sensitivity of 10^{-13} grams of protein. (D. A. Cohen, *Electronics Letters*, **37** (22), 2001, 1358-1360.

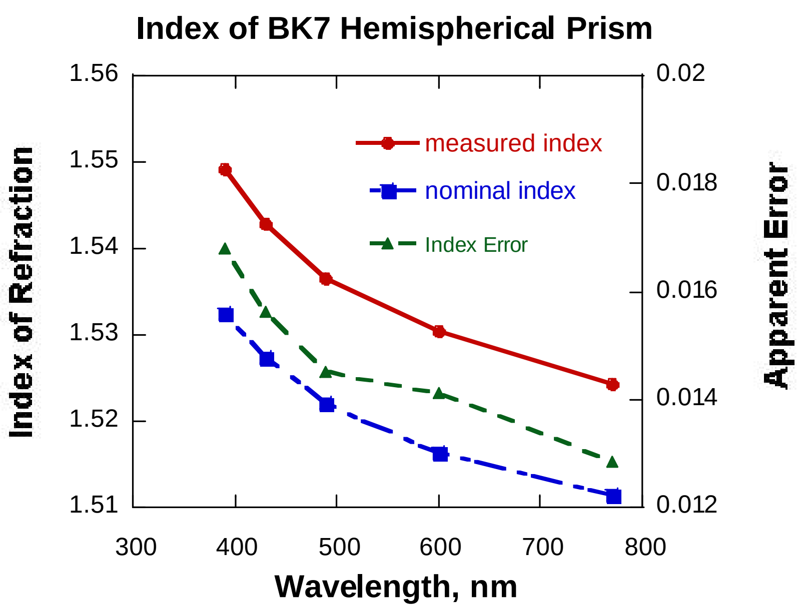

Figure 2. Index of refraction of the hemispherical prism in a Total Internal Reflection (TIR) experiment, measured in air. The apparent error is due to a correctable angular misalignment.